

NUMERICAL MATHEMATICS  
AND SCIENTIFIC COMPUTATION

# Parallel and Sequential Methods for Ordinary Differential Equations

KEVIN BURRAGE



OXFORD SCIENCE PUBLICATIONS

# Parallel And Sequential Methods For Ordinary Differential Equations

**Kevin Burrage**



## **Parallel And Sequential Methods For Ordinary Differential Equations:**

**Parallel and Sequential Methods for Ordinary Differential Equations** Kevin Burrage,1995 High Performance Computing in Science and Engineering, Garching/Munich 2007 Siegfried Wagner,Matthias Steinmetz,Arndt Bode,Matthias Brehm,2008-10-22 For the fourth time the Leibniz Supercomputing Centre LRZ and the Com tence Network for Technical Scienti c High Performance Computing in Bavaria KONWIHR publishes the results from scienti c projects conducted on the c puter systems HLRB I and II High Performance Computer in Bavaria This book reports the research carried out on the HLRB systems within the last three years and compiles the proceedings of the Third Joint HLRB and KONWIHR Result and Reviewing Workshop 3rd and 4th December 2007 in Garching In 2000 HLRB I was the rst system in Europe that was capable of performing more than one Tera op s or one billion oating point operations per second In 2006 it was replaced by HLRB II After a substantial upgrade it now achieves a peak performance of more than 62 Tera op s To install and operate this powerful system LRZ had to move to its new facilities in Garching However the situation regarding the need for more computation cycles has not changed much since 2000 The demand for higher performance is still present a trend that is likely to continue for the foreseeable future Other resources like memory and disk space are currently in suf cient abundance on this new system *High-Performance Computing and Networking* Peter Sloot,Marian Bubak,Bob

Hertzberger,1998-04-15 Proceedings Parallel Computing **Computer Methods for Ordinary Differential Equations and Differential-Algebraic Equations** Uri M. Ascher,Linda R. Petzold,1998-01-01 Designed for those people who want to gain a practical knowledge of modern techniques this book contains all the material necessary for a course on the numerical solution of differential equations Written by two of the field s leading authorities it provides a unified presentation of initial value and boundary value problems in ODEs as well as differential algebraic equations The approach is aimed at a thorough understanding of the issues and methods for practical computation while avoiding an extensive theorem proof type of exposition It also addresses reasons why existing software succeeds or fails This book is a practical and mathematically well informed introduction that emphasizes basic methods and theory issues in the use and development of mathematical software and examples from scientific engineering applications Topics requiring an extensive amount of mathematical development such as symplectic methods for Hamiltonian systems are introduced motivated and included in the exercises but a complete and rigorous mathematical presentation is referenced rather than included **Proceedings of the Fourth**

**SIAM Conference on Parallel Processing for Scientific Computing** J. J. Dongarra,1990-01-01 Proceedings Parallel Computing **Solving Differential Equations by Multistep Initial and Boundary Value Methods** L Brugnano,D Trigiante,1998-05-22 The numerical approximation of solutions of differential equations has been and continues to be one of the principal concerns of numerical analysis and is an active area of research The new generation of parallel computers have provoked a reconsideration of numerical methods This book aims to generalize classical multistep methods for both initial

and boundary value problems to present a self contained theory which embraces and generalizes the classical Dahlquist theory to treat nonclassical problems such as Hamiltonian problems and the mesh selection and to select appropriate methods for a general purpose software capable of solving a wide range of problems efficiently even on parallel computers

**Advances in Numerical Methods** Nikos Mastorakis, John Sakellaris, 2009-07-09 Recent Advances in Numerical Methods features contributions from distinguished researchers focused on significant aspects of current numerical methods and computational mathematics This volume meets the need in the community for new computational methods that can solve complex scientific and engineering problems by presenting innovative methods that provide numerical solutions in effective computing times Each chapter presents new and advanced methods and modern variations of known techniques that can solve difficult scientific problems efficiently and quickly

*Time-parallel Methods for Accelerating the Solution of Structural Dynamics Problems* Julien Remi Cortial, 2011 The classical approach for solving evolution Partial Differential Equations PDEs using a parallel computer consists in first partitioning the spatial domain and assigning each subdomain to a processor to achieve space parallelism then advancing the solution sequentially However enabling parallelism along the time dimension despite its intrinsic difficulty can be of paramount importance to fast computations when space parallelism is unfeasible cannot fully exploit a massively parallel machine or when near real time prediction is desired The aforementioned objective can be achieved by applying classical domain decomposition principles to the time axis The latter is first partitioned into time slices to be processed independently Starting with approximate seed information that provides a set of initial conditions the response is then advanced in parallel in each time slice using a standard time stepping integrator This decomposed solution exhibits discontinuities or jumps at the time slice boundaries if the initial guess is not accurate Applying a Newton like approach to the time dependent system a correction function is then computed to improve the accuracy of the seed values and the process is repeated until convergence is reached Methods based on the above concept have been successfully applied to various problems but none was found to be competitive for even for the simplest of second order hyperbolic PDEs a class of equations that covers the field of structural dynamics among others To overcome this difficulty a key idea is to improve the sequential propagator used for correcting the seed values observing that the original evolution problem and the derived corrective one are closely related The present work first demonstrates how this insight can be brought to fruition in the context of linear oscillators with numerical examples featuring structural models ranging from academic to more challenging large scale ones An extension of this method to nonlinear equations is then developed and its concrete application to geometrically nonlinear transient dynamics is presented Finally it is shown how the time reversibility property that characterizes some of the above problems can be exploited to develop a new framework that provides an increased speed up factor

**Recent Trends in Numerical Analysis** D. Trigiante, 2000 The contributions for this volume dedicated to honour the 65th birthday of Professor I Galligani have been numerous and cover a wide range of topics of the current

Numerical Analysis and of its applications      *Recent Progress in Computational Sciences and Engineering (2 vols)* Theodore Simos, 2019-05-07 This volume brings together selected contributed papers presented at the International Conference of Computational Methods in Science and Engineering ICCMSE 2006 held in Chania Greece October 2006 The conference aims to bring together computational scientists from several disciplines in order to share methods and ideas The ICCMSE is unique in its kind It regroups original contributions from all fields of the traditional Sciences Mathematics Physics Chemistry Biology Medicine and all branches of Engineering It would be perhaps more appropriate to define the ICCMSE as a conference on computational science and its applications to science and engineering Topics of general interest are Computational Mathematics Theoretical Physics and Theoretical Chemistry Computational Engineering and Mechanics Computational Biology and Medicine Computational Geosciences and Meteorology Computational Economics and Finance Scientific Computation High Performance Computing Parallel and Distributed Computing Visualization Problem Solving Environments Numerical Algorithms Modelling and Simulation of Complex System Web based Simulation and Computing Grid based Simulation and Computing Fuzzy Logic Hybrid Computational Methods Data Mining Information Retrieval and Virtual Reality Reliable Computing Image Processing Computational Science and Education etc More than 800 extended abstracts have been submitted for consideration for presentation in ICCMSE 2005 From these 500 have been selected after international peer review by at least two independent reviewers      Parallel Numerical Computation with Applications Laurence Tianruo Yang, 2012-12-06 Parallel Numerical Computations with Applications contains selected edited papers presented at the 1998 Frontiers of Parallel Numerical Computations and Applications Workshop along with invited papers from leading researchers around the world These papers cover a broad spectrum of topics on parallel numerical computation with applications such as advanced parallel numerical and computational optimization methods novel parallel computing techniques numerical fluid mechanics and other applications related to material sciences signal and image processing semiconductor technology and electronic circuits and systems design This state of the art volume will be an up to date resource for researchers in the areas of parallel and distributed computing      *Handbook of Stochastic Analysis and Applications* D. Kannan, V. Lakshmikantham, 2001-10-23 An introduction to general theories of stochastic processes and modern martingale theory The volume focuses on consistency stability and contractivity under geometric invariance in numerical analysis and discusses problems related to implementation simulation variable step size algorithms and random number generation      **Parallel Computing Technologies** Victor Malyshev, 2011-09-10 This book constitutes the proceedings of the 11th International Conference on Parallel Computing Technologies PaCT 2011 held in Kazan Russia on September 19 23 2011 The 44 full papers presented together with 2 invited papers were carefully reviewed and selected from 68 submissions The papers are organized in topical sections on models and languages cellular automata parallel programming tools and support and applications      **Multiple Shooting and Time Domain Decomposition Methods**

Thomas Carraro, Michael Geiger, Stefan Körkel, Rolf Rannacher, 2015-10-26 This book offers a comprehensive collection of the most advanced numerical techniques for the efficient and effective solution of simulation and optimization problems governed by systems of time dependent differential equations. The contributions present various approaches to time domain decomposition focusing on multiple shooting and parareal algorithms. The range of topics covers theoretical analysis of the methods as well as their algorithmic formulation and guidelines for practical implementation. Selected examples show that the discussed approaches are mandatory for the solution of challenging practical problems. The practicability and efficiency of the presented methods is illustrated by several case studies from fluid dynamics, data compression, image processing and computational biology, giving rise to possible new research topics. This volume, resulting from the workshop Multiple Shooting and Time Domain Decomposition Methods held in Heidelberg in May 2013, will be of great interest to applied mathematicians, computer scientists and all scientists using mathematical methods.

**Mathematical Methods for the Magnetohydrodynamics of Liquid Metals** Jean-Frédéric Gerbeau, Claude Le Bris, Tony Lelièvre, 2006-08-31 This comprehensive text focuses on mathematical and numerical techniques for the simulation of magnetohydrodynamic phenomena, with an emphasis laid on the magnetohydrodynamics of liquid metals and on a prototypical industrial application. Aimed at research mathematicians, engineers and physicists as well as those working in industry, and starting from a good understanding of the physics at play, the approach is a highly mathematical one based on the rigorous analysis of the equations at hand and a solid numerical analysis to found the simulations. At each stage of the exposition, examples of numerical simulations are provided: first on academic test cases to illustrate the approach, next on benchmarks well documented in the professional literature, and finally, whenever possible, on real industrial cases.

**Mathematical and Computational Methods for Compressible Flow** Miloslav Feistauer, Jiří Felcman, Ivan Straškraba, 2003 This book is concerned with mathematical and numerical methods for compressible flow. It aims to provide the reader with a sufficiently detailed and extensive, mathematically precise but comprehensible guide through a wide spectrum of mathematical and computational methods used in Computational Fluid Dynamics (CFD) for the numerical simulation of compressible flow. Up to date techniques applied in the numerical solution of inviscid as well as viscous compressible flow on unstructured meshes are explained, thus allowing the simulation of complex three dimensional technically relevant problems. Among some of the methods addressed are finite volume methods using approximate Riemann solvers, finite element techniques such as the streamline diffusion and the discontinuous Galerkin methods, and combined finite volume/finite element schemes. The book gives a complex insight into the numerics of compressible flow, covering the development of numerical schemes and their theoretical/mathematical analysis, their verification on test problems, and use in solving practical engineering problems. The book will be helpful to specialists coming into contact with CFD: pure and applied mathematicians, aerodynamists, engineers, physicists and natural scientists. It will also be suitable for advanced undergraduate, graduate and postgraduate students of

mathematics and technical sciences

**Time Parallel Time Integration** Martin J. Gander, Thibaut Lunet, 2024-10-15

Predicting the future is a difficult task but as with the weather it is possible with good models But how does one predict the far future before the near future is known Time parallel time integration also known as PinT Parallel in Time methods aims to predict the near and far future simultaneously In this self contained book the first on the topic readers will find a comprehensive and up to date description of methods and techniques that have been developed to do just this The authors describe the four main classes of PinT methods shooting type methods waveform relaxation methods time parallel multigrid methods and direct time parallel methods In addition they provide historical background for each of the method classes complete convergence analyses for the most representative variants of the methods in each class and illustrations and runnable MATLAB code An ideal introduction to this exciting and very active research field Time Parallel Time Integration can be used for independent study or for a graduate course

Biomedical Engineering and Neuroscience Wojciech P.

Hunek, Szczepan Paszkiel, 2018-02-06 This edition of the volume Advances in Intelligent Systems and Computing presents the proceedings of the 3rd International Scientific Conference BCI The event was held at Opole University of Technology in Poland on 13 and 14 March 2018 Since 2014 the conference has taken place every two years at the University's Faculty of Electrical Engineering Automatic Control and Informatics The conference focused on the issues relating to new trends in modern brain computer interfaces BCI and control engineering including neurobiology neurosurgery cognitive science bioethics biophysics biochemistry modeling neuroinformatics BCI technology biomedical engineering control and robotics computer engineering and neurorehabilitation biofeedback In addition to paper presentations the scientific program also included a number of practical demonstrations covering for example the on line control of mobile robot and unmanned aerial vehicle using the BCI technology

ICIAM 91 Robert E. O'Malley, 1992-01-01 Proceedings Computer Arithmetic Algebra

OOP Recent Advances in Parallel Virtual Machine and Message Passing Interface Beniamino Di Martino, Dieter Kranzlmüller, Jack Dongarra, 2005-09-05 This book constitutes the refereed proceedings of the 12th European PVM MPI Users Group Meeting held in Sorrento Italy in September 2005 The 61 revised full papers presented together with abstracts of 6 invited contributions were carefully reviewed and selected from numerous submissions The papers are organized in topical sections on algorithms extensions and improvements cluster and grid tools and environments performance applications and ParSim 2005

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## **Table of Contents Parallel And Sequential Methods For Ordinary Differential Equations**

1. Understanding the eBook Parallel And Sequential Methods For Ordinary Differential Equations
  - The Rise of Digital Reading Parallel And Sequential Methods For Ordinary Differential Equations
  - Advantages of eBooks Over Traditional Books
2. Identifying Parallel And Sequential Methods For Ordinary Differential Equations
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Parallel And Sequential Methods For Ordinary Differential Equations
  - User-Friendly Interface
4. Exploring eBook Recommendations from Parallel And Sequential Methods For Ordinary Differential Equations
  - Personalized Recommendations
  - Parallel And Sequential Methods For Ordinary Differential Equations User Reviews and Ratings
  - Parallel And Sequential Methods For Ordinary Differential Equations and Bestseller Lists
5. Accessing Parallel And Sequential Methods For Ordinary Differential Equations Free and Paid eBooks



- Parallel And Sequential Methods For Ordinary Differential Equations Public Domain eBooks
  - Parallel And Sequential Methods For Ordinary Differential Equations eBook Subscription Services
  - Parallel And Sequential Methods For Ordinary Differential Equations Budget-Friendly Options
6. Navigating Parallel And Sequential Methods For Ordinary Differential Equations eBook Formats
- ePub, PDF, MOBI, and More
  - Parallel And Sequential Methods For Ordinary Differential Equations Compatibility with Devices
  - Parallel And Sequential Methods For Ordinary Differential Equations Enhanced eBook Features
7. Enhancing Your Reading Experience
- Adjustable Fonts and Text Sizes of Parallel And Sequential Methods For Ordinary Differential Equations
  - Highlighting and Note-Taking Parallel And Sequential Methods For Ordinary Differential Equations
  - Interactive Elements Parallel And Sequential Methods For Ordinary Differential Equations
8. Staying Engaged with Parallel And Sequential Methods For Ordinary Differential Equations
- Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Parallel And Sequential Methods For Ordinary Differential Equations
9. Balancing eBooks and Physical Books Parallel And Sequential Methods For Ordinary Differential Equations
- Benefits of a Digital Library
  - Creating a Diverse Reading Collection Parallel And Sequential Methods For Ordinary Differential Equations
10. Overcoming Reading Challenges
- Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
11. Cultivating a Reading Routine Parallel And Sequential Methods For Ordinary Differential Equations
- Setting Reading Goals Parallel And Sequential Methods For Ordinary Differential Equations
  - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Parallel And Sequential Methods For Ordinary Differential Equations
- Fact-Checking eBook Content of Parallel And Sequential Methods For Ordinary Differential Equations
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning
- Utilizing eBooks for Skill Development

- Exploring Educational eBooks

#### 14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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